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**Separating and reattaching turbulent boundary layer due to an unsteady adverse pressure gradient**[1] JUNSHIN PARK, DONGHYUN YOU, Pohang University of Science and Technology — Turbulent boundary layer subject to an unsteady adverse pressure gradient (APG) is studied using direct numerical simulation (DNS). The unsteady APG is imposed with a suction/blowing velocity profile at the top numerical boundary to evoke boundary layer separation and reattachment. In particular, the suction/blowing velocity profile is varied sinusoidally in time at several different reduced frequencies: $k = 3.75$, 0.75 and 0.25. Results have shown that for reduced frequencies $k = 0.75$ and 0.25, flow features differ greatly from those of separated flow with a steady APG. The separated shear layer lifts up at the first half-period of the APG oscillation. Flow near the reattachment region is entrained back inside the separation bubble. Large vortices are subsequently generated and convect downstream while the separated shear layer leans down to the wall at the latter half-period of the APG oscillation. Differences in time-averaged turbulent kinetic energy are also observed compared with the steady counterpart. To investigate the origin of such differences between flows with steady and unsteady APG, dynamic mode decomposition is also applied. Identified dynamic modes show features related to the aforementioned unsteady behavior.

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